An AC Magnetometer using Automatic Frequency Switching of A Resonant Excitation Coil for Magnetic Nanoparticles Characterization

Mohd Mawardi Saari, Mohd Aufa Hadi Putera Zaini, Hamzah Ahmad

Faculty of Electrical & Electronic Engineering
Universiti Malaysia Pahang, Pekan Campus, 26600 Pekan, Pahang, Malaysia

Nurul Akmal Che Lah

Innovative, Manufacturing, Mechatronics and Sports Lab (iMAMS Lab),
Faculty of Manufacturing Engineering, University Malaysia Pahang,
Pekan Campus, 26600 Pekan, Pahang, Malaysia

Abstract — An AC magnetometer using a resonant excitation coil is presented for magnetic nanoparticles characterization. An automatic resonant frequency switching of the excitation coil circuit is developed to reduce the measurement time and human contributed errors. A network capacitor consists of 13 different capacitance values is fabricated and controlled by using a relay module and a microcontroller. The resonant circuit of the excitation coil is resonated up to 81.36 kHz to reduce its impedance observed by a current amplifier. The impedance of the resonant excitation coil is evaluated to access the effectiveness of the resonant technique. A first-order differential coil is used to sense the magnetization from a sample and its sensitivity with respect to magnetic moment and frequency is measured. Using the developed system, we measure the complex magnetization of a multi-core iron oxide nanoparticles solution and estimated its hydrodynamic size.

Keywords: *AC susceptibility, magnetometer, magnetic nanoparticles, coil*